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A Community Ice Sheet Model for Sea Level Prediction

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MEETING

A Community Ice Sheet Model for Sea Level Prediction

Building a Next-Generation Community Ice Sheet Model; Los Alamos, New Mexico, 18–20 August 2008

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Recent observations show that ice sheets can respond to climate change on annual to decadal timescales and that the Greenland and West Antarctic ice sheets are losing mass at an increasing rate. The current generation of ice sheet models cannot provide credible predictions of ice sheet retreat, as underscored by the Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment Report (2007). The IPCC provided neither a best estimate nor an upper bound for 21st-century sea level rise because of uncertainties in the dynamic response of ice sheets.

In response to this need, a workshop was held at Los Alamos National Laboratory (LANL). The workshop was sponsored by the LANL Institute for Geophysics and Planetary Physics, with additional support from the U.S. Department of Energy and National Science Foundation. The workshop's goal was to create a detailed plan (including commitments from individual researchers) for developing, testing, and implementing a Community Ice Sheet Model (CISM) to aid in predicting sea level rise. This model will be freely available to the glaciology and climate modeling communities and will be the ice sheet component of the Community Climate System Model (CCSM), a major contributor to IPCC assessments.

The workshop was attended by 35 scientists from U.S., U.K., and Canadian institutions. The discussion was organized around four focus areas: (1) ice sheet dynamics and physics, (2) ice shelf/ocean interactions, (3) software design and coupling, and (4) initialization, verification, and validation. Because of the short timescale for including ice sheet forecasts in the next IPCC assessment, participants prioritized model improvements according to their importance for sea level prediction. The following improvements were deemed critical:

- a higher-order flow model with a unified treatment of vertical shear stresses and horizontal-plane stresses;
- improved models of basal sliding over hard and soft beds, with explicit ice sheet hydrology;
- a well-validated parameterization of melting and refreezing beneath ice shelves;
- an accurate, semiempirical law for iceberg calving; and
- an accurate, numerically robust treatment of grounding-line migration.

Workshop participants also agreed that CISM should be modular, portable, and user-friendly, with transparent source code supplemented by data sets for initialization, forcing, and validation. The model should scale efficiently to hundreds or thousands of processors, using existing parallel solvers (e.g., Portable, Extensible Toolkit for Scientific Computation (PETSc); http://www-unix.mcs.anl.gov/petsc/petsc-as/) and infrastructure from other Earth system models (e.g., CICE; http://climate.lanl.gov/Models/CICE/). Because warm-water intrusions beneath ice shelves could drive rapid ice sheet retreat, new methods are needed for coupling ocean models to ice sheet models, attendees noted. Software development is proceeding from the GLIMMER model (http://forge.nesc.ac.uk/projects/glimmer/), which has already been coupled to CCSM.

Six focus groups have formed to guide ongoing CISM development. These groups are working on hydrology, calving, ice-ocean coupling, software development, data sets, and climate assessment. In the near term the assessment group will use the best available current models to provide quantitative upper bounds for sea level rise; these assessments will inform longer-term model development. CISM source code and tools will be posted on a public Web site.

For more information, including workshop presentations, focus group reports, and the full workshop report, please visit http://oceans11.lanl.gov/trac/CISM.

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ABOUT AGU

Melosh Receives 2008 Harry H. Hess Medal

H. Jay Melosh was awarded the 2008 Harry H. Hess Medal at the AGU Fall Meeting Honors Ceremony, held 17 December 2008 in San Francisco, Calif. The medal is for "outstanding achievements in research in the constitution and evolution of Earth and sister planets."

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Citation

H. Jay Melosh is a worthy recipient of the AGU Harry H. Hess Medal for "outstanding achievements in research in the constitution and evolution of Earth and sister planets." Jay is a world-class Earth and planetary scientist. He is responsible for a number of predictions, innovations, and contributions to our understanding of important phenomena in geophysics and planetary physics. Jay is the world's expert on collisional/cratering processes in the solar system, processes that are perhaps the most important in shaping the planets and other bodies in space.

Jay is an extraordinarily original thinker. Most of Jay's research in the Earth and planetary sciences has focused on the application of physical principles to the understanding of the forces that shape the surfaces of the Earth and other planets. One of his most original contributions is the

H. Jay Melosh